

Effect of aerobic bacteriology on the clinical presentation and treatment results of chronic suppurative otitis media

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Abstract

The effect of aerobic bacteriology on the clinical presentation, complications of the disease and long-term results of surgical treatment was assessed in a cohort of 368 patients with chronic suppurative otitis media. Bacteriological findings showed no significant difference between child and adult patients. *Staphylococcus aureus* was isolated in cholesteatoma ears more frequently than *Pseudomonas aeruginosa*, in chronic ears without cholesteatoma the situation was reversed. Bacteriological findings had no significant effect on the incidence of complications caused by the disease. Failures after surgical treatment were most common in *Pseudomonas* ears. The bacteriology had no significant effect on pre-operative hearing levels nor post-operative hearing results. It was concluded that, in order to improve results of chronic ear surgery, more attention should be paid to pre-operative conservative treatment of chronically discharging ears, especially those infected by *P. aeruginosa*.

Key words: Otitis media, suppurative; Bacteriology; Mastoid surgery

Introduction

The aerobic bacteriology of chronic suppurative otitis media (CSOM) is widely studied, *Pseudomonas aeruginosa* and *Staphylococcus aureus* being found to be the most commonly associated organisms (Karma *et al.*, 1978; Brook, 1981; Kenna and Bluestone, 1986; Fliss *et al.*, 1992). The presence of anaerobes in CSOM has also been documented but their role in this disease is not clear (Karma *et al.*, 1978; Brook, 1981; Bluestone and Kenna, 1984). It seems that the bacteriology of CSOM has not changed during the last decades and that there are no geographical or ethnological differences.

Little attention has been paid to the effect of bacteriology on the presentation of CSOM and to the incidence of complications caused by this disease. Furthermore, it is unknown whether bacteriological findings have some effect on the results of surgical treatment for CSOM. The present study was designed to assess these topics.

Materials and methods

The study population was comprised of 368 patients with CSOM treated in the Department of Otolaryngology, University Hospital of Kuopio, Kuopio, Finland, between 1976 and 1990. Patients with dry chronic ears were excluded from the study. In addition, 21 discharging ears lacking microbiological examination were excluded.

Specimens for bacteriological examination were obtained directly from the middle ear through a perforation using small swabs or small calibre sterile tubes and cultured using standard techniques. Anaerobic studies were not performed.

The majority (87 per cent) of 201 patients with cholesteatoma underwent canal wall down mastoidectomy with tympanoplasty, the remaining patients with cholesteatoma were subjected to radical mastoidectomy with open cavity (three per cent), canal wall up mastoidectomy (seven per cent), atticotomy (one per cent) or tympanoplasty without mastoidectomy (two per cent). One hundred and sixty-seven patients without cholesteatoma underwent either tympanomastoidectomy (83 per cent) or cortical mastoidectomy (17 per cent).

After surgery, every patient was regularly checked

TABLE I
BACTERIOLOGICAL FINDINGS RELATED TO THE AGE OF THE PATIENT

	Age			
	<16 years		≥16 years	
	n	(%)	n	(%)
<i>P. aeruginosa</i>	16	(25)	56	(18)
<i>Staph. aureus</i>	12	(18)	60	(20)
<i>Proteus</i> spp.	3	(5)	23	(8)
Other bacteria or polyinfection	26	(40)	103	(34)
No growth	8	(12)	61	(20)
Total	65		303	

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TABLE II
NUMBER OF COMPLICATIONS CAUSED BY THE DISEASE

	Total number of ears	Anacusis	Labyrinthine fistula	Facial palsy	Meningitis	Brain abscess
<i>P. aeruginosa</i>	72	4	1	1	–	1
<i>Staph. aureus</i>	72	1	2	–	–	–
<i>Proteus</i> spp.	26	–	1	–	–	–
Other bacteria or polyinfection	129	11	3	–	1	–
No growth	69	4	2	–	–	2
All	368	20	9	1	1	3

on an out-patient basis. All patients had a follow-up of at least 12 months, the mean follow-up period being 7.1 years.

Audiological examination was performed using a clinical audiometer calibrated according to the standards of the International Standard Organization (ISO). Audiograms obtained the day before operation and at last follow-up examination (or the day before revision operation) were recorded. The pure tone average (PTA), calculated by hearing thresholds for 0.5, 1, and 2 kHz was used for analyses. Post-operative hearing gain was calculated subtracting the PTA for air conduction at last follow-up examination from the pre-operative PTA for air conduction.

Mann-Whitney U test, Kruskal-Wallis test, *t*-test and Chi-squared test were used for statistical analyses in the appropriate cases. *P* values less than 0.05 were considered significant.

Results

Pseudomonas aeruginosa and *Staphylococcus aureus* were the most commonly isolated bacteria, followed by *Proteus* species. Other aerobic organisms were uncommon and in the statistical analyses these cases were included in the group of ears showing mixed flora (polyinfection).

Bacteriological findings showed no statistically significant difference between child and adult patients, though *P. aeruginosa* was slightly more common in children than in adults (Table I).

Pre-operative complications caused by the disease

TABLE III
BACTERIOLOGICAL FINDINGS RELATED TO THE UNDERLYING DISEASE

	Cholesteatoma		CSOM	
	n	(%)	n	(%)
<i>P. aeruginosa</i>	34	(17)	38	(23)
<i>Staph. aureus</i>	46	(23)	26	(16)
<i>Proteus</i> spp.	17	(8)	9	(5)
Other bacteria or polyinfection	65	(32)	64	(38)
No growth	39	(19)	30	(18)
Total	201		167	

CSOM = chronic suppurative otitis media without cholesteatoma

are listed in Table II. The incidence of anacusis showed no significant difference between various bacteriological groups. Labyrinthine fistulas were detected in all groups. Intracranial complications were rare.

At surgery, a cholesteatoma was found significantly ($p < 0.05$) more often in chronic ears infected by *Staph. aureus* than in ears infected by *P. aeruginosa*, otherwise bacteriology of patients with cholesteatoma did not differ significantly from that of patients without cholesteatoma (Table III). Eroded ossicles were observed more often in ears from which *Proteus* strains were isolated than in other chronically discharging ears (Table IV).

Persistent or recurrent otorrhoea, recurrence of cholesteatoma and graft failures were considered failures of surgical treatment. As can be seen in Table V, control of infection succeeded significantly ($p < 0.05$) less often in *Pseudomonas* ears than in *Staph. aureus* group and the group of other bacteria and polyinfection. Recurrence of cholesteatoma occurred in the *Staph. aureus* group significantly ($p < 0.05$) more often than in the other bacteria and polyinfection groups. The total number of failures was greatest in cases of pseudomonas infection.

No significant differences were noted in the mean pre-operative and post-operative air conduction thresholds and post-operative hearing gain between study groups (Table VI).

Discussion

In the developed countries, intracranial complications of CSOM are rare, in this series only four (one per cent) of the 368 patients presented with such a serious complication. In developing countries intracranial otogenic complications are still often encoun-

TABLE IV
NUMBER OF CHRONIC EARS WITH ERODED OSSICLES (EXCLUDING TOTALLY DEAF EARS)

	Total number of ears	Ears with eroded ossicles n	(%)
<i>P. aeruginosa</i>	68	34	(50)
<i>Staph. aureus</i>	71	40	(56)
<i>Proteus</i> spp.	26	20	(77)
Other bacteria or polyinfection	118	53	(45)
No growth	65	36	(55)

TABLE V
TREATMENT FAILURES RELATED TO THE BACTERIOLOGY

	Total number of ears	Recurrent infection		Recurrence of cholesteatoma		Graft failure		Total number of failures	
		n	(%)	n	(%)	n	(%)	n	(%)
<i>P. aeruginosa</i>	72	9	(13)	5	(7)	11	(15)	25	(35)
<i>Staph. aureus</i>	72	2	(3)	9	(13)	5	(7)	16	(22)
<i>Proteus</i> spp.	26	1	(4)	–	–	4	(15)	5	(19)
Other bacteria or polyinfection	129	5	(3)	5	(3)	10	(8)	20	(16)
No growth	69	7	(10)	7	(10)	6	(9)	20	(29)
All	368	24	(7)	26	(7)	36	(10)	86	(23)

TABLE VI
MEAN PRE- AND POST-OPERATIVE AIR CONDUCTION (AC) THRESHOLDS AND POST-OPERATIVE HEARING GAIN

	AC thresholds				Hearing gain	
	Pre-operative Mean	Pre-operative (SD)	Post-operative Mean	Post-operative (SD)	Mean	(SD)
<i>P. aeruginosa</i>	47.6	(16.9)	38.6	(21.9)	6.6	(16.2)
<i>Staph. aureus</i>	43.0	(17.0)	33.8	(17.4)	7.9	(13.4)
<i>Proteus</i> spp.	45.8	(22.2)	37.6	(21.1)	8.2	(12.5)
Other bacteria or polyinfection	44.0	(19.2)	35.5	(21.9)	7.1	(15.0)
No growth	44.6	(20.2)	37.2	(22.1)	7.4	(13.6)
All	44.7	(18.8)	36.2	(20.9)	7.3	(14.4)

tered. In a series of 43 patients with these complications recently published from Thailand (Kangsanarak *et al.*, 1993), *Proteus* strains, *Pseudomonas aeruginosa* and staphylococci were the most common organisms isolated, ie, the same bacteria most frequently found in all chronic ears, including the present series. In a study from India including 47 patients with otogenic intracranial complications, 63 per cent of specimens grew mixed flora with *Proteus* species being predominant (Rupa and Raman, 1991).

Profound sensorineural hearing loss is a not uncommon complication of CSOM, with the incidence of five per cent in the present series. It seems that there is no single bacterial group that causes this complication.

Eroded ossicles were detected more often in the *Proteus* group than in other chronic ears. However, the small number (26) of *Proteus* ears lessens the significance of this finding. Kärja *et al.* (1976) observed no significant differences as regards destruction of ossicles in chronic ear disease caused by one or other of the three most common bacteria, *Staph. aureus*, *P. aeruginosa* and *Proteus* strains, although the percentage of ears with eroded ossicles was highest in the *Proteus* group.

When viewing the effect of bacteriology on the results of treatment for CSOM, control of infection certainly is the most important subject. In this respect, results of patients with pseudomonal infection were poorest. It seems that *P. aeruginosa* causes the most therapy-resistant chronic ear infections, probably due to its ability to carve out a niche for itself in a local infection through the necrotizing activities of its extracellular enzymes. The physical characteristics of the niche, damaged epithelium,

interrupted circulation and devitalized tissue, protect the organism from normal host defence mechanisms and antibiotic agents (Pollack, 1988).

Control of infection failed fairly often or in 10 per cent of ears from which no organism could be isolated. Many of these patients had received antibiotic therapy before the culture specimens were obtained but one would speculate on the role of anaerobic infection in these ears (anaerobic organisms were not identified). The significance of anaerobic bacteria in association with CSOM has been stressed by some authors (Brook, 1981; Fairbanks, 1981).

The incidence of recurrence of cholesteatoma was highest in ears infected by *Staph. aureus* but many other factors, such as age of the patient, size and site of the cholesteatoma and the surgical technique used, have been shown to have a significant effect on the recurrence rate of cholesteatoma, especially on the incidence of residual cholesteatoma (Mercke, 1986; Quaranta *et al.*, 1988; Vartiainen, 1995).

To improve results of surgical treatment for CSOM more attention should be paid to pre-operative conservative treatment of chronically discharging ears, especially those infected by *P. aeruginosa*. Currently, we have effective and non-toxic antibiotics against *P. aeruginosa*. Using these antibiotics together with repeated aural toilet or microscopic suction clearance pre-operatively and, later, in association with surgical treatment, better control of infection would be expected.

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